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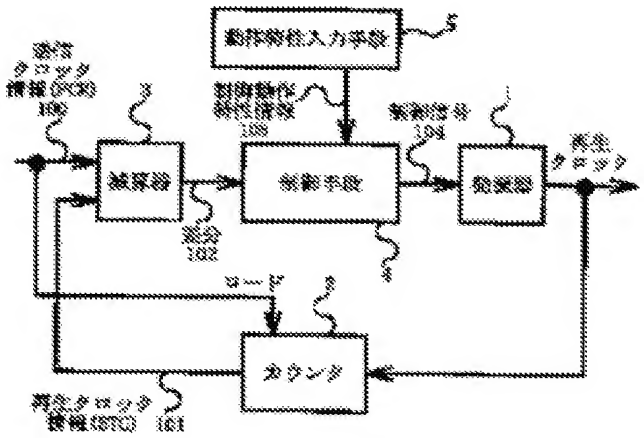
Abstract:
PROBLEM TO BE SOLVED: To attain optimal clock reproduction control corresponding to various kinds of situations by controlling the reproduction clock frequency of a reproduction clock outputting means by a control means based on control operation characteristic information inputted from an operation characteristic inputting means. SOLUTION: An operation characteristic inputting means 5 can input information related with the operation characteristics to a control means 4, and the information is set in the control means 4. The control means 4 generates a control signal 104 to an oscillator 1 from a difference 102 based on the set operation characteristics from the operation characteristic inputting means 5. Also, the control means 104 holds the clock information difference 102. The various kinds of methods are considered for the generation of the control signal 104 to be generated by the control means 4, and in this case, the control means 4 generates the control signal 104 based on the control operation characteristic information 105 inputted from the operation characteristic inputting means 5, and executes control so that the clock reproduction of the oscillator 1 can be optimally attained.



JPO Machine translation abstract:

(57) **Abstract**

SUBJECT It enables it to perform optimal clock reproduction control in various situations in the clock reproduction equipment which reproduces the same clock as a sending set by a receiver.

Means for Solution By establishing the operating characteristic input means 5 and notifying a receiving interval of a transmit clock, information on fluctuation of a transmission line, etc. to the control means 4 which performs clock reproduction control, the operating characteristic of a control means is changed and optimal clock reproduction control is performed in the situation.

Claim(s)

Claim 1 Clock reproduction equipment which is provided with the following and characterized by the above-mentioned control means controlling a reproducing clock frequency of the above-mentioned reproduction clock output means based on control action characteristic information inputted from this operating characteristic input means.

A reproduction clock output means which outputs a reproduction clock.

A clock difference detection means which detects difference with reproduction clock information which shows frequency of a reproduction clock outputted from transmit-clock information which shows a transmitting side clock frequency, and the above-mentioned reproduction clock output means.

A control means which controls a reproducing clock frequency of the above-mentioned reproduction clock output means based on the above-mentioned difference from this clock difference detection means.

An operating characteristic input means which inputs control action characteristic information to this control means.

Claim 2 While the above-mentioned operating characteristic input means is provided with a fluctuation information setting means to set up fluctuation information added to the above-mentioned difference, and to output as control action characteristic information, The clock reproduction equipment according to claim 1, wherein the above-mentioned control means controls a reproducing clock frequency based on fluctuation information set up by this fluctuation information setting means.

Claim 3 The above-mentioned control means is provided with a gain means which generates a control signal to the above-mentioned reproduction clock output means based on the inputted above-mentioned difference, The clock reproduction equipment according to claim 2 enlarging a gain in the above-mentioned gain means when fluctuation is small, and making a gain small based on fluctuation information set up by the above-mentioned fluctuation information setting means when fluctuation is large.

Claim 4 The above-mentioned control means is provided with a low pass filter processing means which takes out inputted low frequency components of the above-mentioned difference, The clock reproduction equipment according to any one of claims 2 to 3 making high a cut off frequency of the above-mentioned low pass filter processing means when fluctuation is small, and making a cut off frequency low based on fluctuation information

set up by the above-mentioned fluctuation information setting means when fluctuation is large.
Claim 5 As the above-mentioned fluctuation information setting means, The clock reproduction equipment according to any one of claims 2 to 4 forming a fluctuation detection means to detect a size of fluctuation and to set up as fluctuation information by **of a rate of a temporal change of difference outputted from the above-mentioned clock difference detection means** computing the rate of change further.
Claim 6 While the above-mentioned operating characteristic input means is provided with a reproduction clock state setting-out means to set up that the above-mentioned reproduction clock is a stable state, The clock reproduction equipment according to claim 1, wherein the above-mentioned control means controls a reproducing clock frequency based on a state of a reproduction clock set as this reproduction clock stable state setting-out means.
Claim 7 The above-mentioned control means is provided with a low pass filter processing means which takes out inputted low frequency components of the above-mentioned difference, The clock reproduction equipment according to claim 6 characterized by making low a cut off frequency of the above-mentioned low pass filter processing means when it is set up by the above-mentioned reproduction clock state setting-out means that a reproduction clock is a stable state.
Claim 8 The clock reproduction equipment according to any one of claims 6 to 7 forming a difference rate-of-change detection means to set up that the above-mentioned reproduction clock is a stable state when a rate of a temporal change of difference outputted from the above-mentioned clock difference detection means was detected and this rate of a temporal change became smaller than a predetermined value.
Claim 9 The above-mentioned operating characteristic input means is provided with a fluctuation information setting means to set up fluctuation information added to the above-mentioned difference, and to output as control action characteristic information, The clock reproduction equipment according to claim 8, wherein the above-mentioned difference rate-of-change detection means sets up the above-mentioned predetermined value based on fluctuation information set up by this fluctuation information setting means.
Claim 10 While the above-mentioned operating characteristic input means is provided with a receiving interval setting-out means to set up an interval which receives the above-mentioned transmit-clock information, and to output as control action characteristic information, The clock reproduction equipment according to claim 1, wherein the above-mentioned control means controls a reproducing clock frequency based on a receiving interval set up by this receiving interval setting-out means.
Claim 11 The above-mentioned control means is provided with a gain means which generates a control signal to the above-mentioned reproduction clock output means based on the inputted above-mentioned difference, The clock reproduction equipment according to claim 10 enlarging a gain in the above-mentioned gain means when a receiving interval set up by the above-mentioned receiving interval setting-out means is small, and making a gain small when the above-mentioned receiving interval is large.
Claim 12 The clock reproduction equipment according to any one of claims 10 to 11 forming a receiving interval detection means to detect an interval which receives the above-mentioned transmit-clock information, and to set up as the above-mentioned receiving interval.
Claim 13A clock reproduction method controlling the above-mentioned reproducing clock frequency based on fluctuation information which detected difference with reproduction clock information which shows frequency of transmit-clock information and a reproduction clock in which a transmitting side clock frequency is shown, and was set to this detected difference.
Claim 14A clock reproduction method controlling the above-mentioned reproducing clock frequency based on a state of a reproduction clock which detected difference with reproduction clock information which shows frequency of transmit-clock information and a reproduction clock in which a transmitting side clock frequency is shown, and was set to this detected difference.
Claim 15A clock reproduction method controlling the above-mentioned reproducing clock frequency based on a receiving interval which detected difference with reproduction clock information which shows frequency of transmit-clock information and a reproduction clock in which a transmitting side clock frequency is shown, and was set to this detected difference.

Detailed Description of the Invention
0001
Field of the Invention In the equipment which performs communication and broadcast, this invention relates to the clock reproduction method which reproduces the clock of the transmitting side by a receiver using the clock information sent out from the transmitting side.
0002
Description of the Prior Art Drawing 17 For example, an ITU-T white book, Are a block diagram showing conventional clock reproduction equipment as shown in advice H.222.0 (182 pages - 184 pages) of audio-visual one / multimedia related (H series) advice collection (Heisei 7(1995) February 18 ITU Association of Japan issue), and 11 in a figure A voltage controlled oscillator, A subtractor and 14 are a low pass filter and a gain the counter which operates with the reproduction clock with which 12 is outputted from this voltage oscillator 11, and 13.
0003 The clock information sent out from the transmitting side in the above-mentioned advice PCR (program clock reference), The clock information reproduced by a receiver is called STC (system time clock), and the

counter value of the counter which operates with the clock which uses PCR at the transmitting side, and STC are the counter values of the above-mentioned counter 12 which operates with the clock reproduced by the receiver. The difference of PCR and STC which are asked for 15 with the above-mentioned subtractor 13, and 16 are control voltage outputted to the above-mentioned voltage controlled oscillator 11 from a low pass filter and the gain 14.

0004 Next, operation is explained. When reproducing the clock of the transmitting side in a receiver, the transmit-clock information (PCR) 100 which arrived first is loaded to the counter 12. The counter 12 performs count operation with the reproduction clock which the voltage controlled oscillator 11 outputs. Here, if the 2nd PCR100 arrives, the reproduction clock information (STC) 101 which is an output of the counter 12 at this time will be inputted into the subtractor 13, and the difference 15 of the 2nd PCR100 that arrived will be called for.

0005 Since PCR100 is a value of the counter which operates with the clock of a sending set and STC101 is a value of the counter which operates with the clock of a receiving set, the difference of PCR100 and STC101 shows the quantity resulting from the difference of the frequency between the clock of a sending set, and the clock of a receiving set. For example, if the clock frequency of a sending set is higher than the clock frequency of a receiving set 20 Hz, the increment of the counted value of PCR100 will serve as a large value 20 from the increment of the counted value of STC101 in 1 second. Therefore, if the difference 10 of PCR100 and STC101 is the same value in last time and this time, since the number counted in same time is the same, frequency is that it is the same.

0006 If it becomes the same whenever it arrives, it is shown **this difference of whose is PCR100** that the progress condition of the counter became the same, i.e., transmitting side frequency and reproduction frequency are the same. The quantity from which the difference 15 outputted from the subtractor 13 is changed into the control voltage 16 on a low pass filter and the gain 14, the frequency of the voltage controlled oscillator 11 changes, the output of the counter 12 changes in connection with it, and the difference of PCR100 and STC101 changes decreases gradually.

0007 So that the above-mentioned operation may be repeated whenever PCR100 arrives, and it may become fixed outputting (difference of PCR100 and STC101) of the subtractor 13, That is, by controlling the frequency of the voltage controlled oscillator 13 so that the value counted up in same time becomes equal to the transmitting side, clock reproduction of the same frequency as the transmitting side is performed.

0008 The clock reproduction of the same frequency as the transmitting side is made, and the difference of PCR100 and STC101 usually maintains constant value (offset) in the state of being stable. Since this loads PCR100 to the counter 12 at first, there is no offset at this time, but since it is before the reproduction motion of transmitting side frequency, transmitting side frequency and reproduction frequency have shifted.
It is because PCR100 and a counter value will have offset in the state where it was stabilized since reproduction frequency was controlled so that it shifts gradually and difference becomes fixed in connection with reproduction motion.

0009 If transmission of data is simultaneously required from two or more equipment when carrying out multiplex transmission of the data of two or more communication apparatus, for example in the network of ATM (Asynchronous Transfer Mode), if a network is used when communicating, In a network, since it cannot transmit simultaneously, those data is transmitted one by one. The send data of a transmit terminal remains in a network temporarily by this, and the interval of transmission of the data transmitted from a sending set is no longer held with a receiving terminal. Such a situation is said that a transmission line (network) has fluctuation.

0010 When fluctuation exists in a transmission line, the receiving timing of PCR will also swing and the difference 15 will stop thus, expressing the difference of the clock frequency of the transmitting side and a receiver with the influence of fluctuation of the receiving timing of this PCR correctly by fluctuation of a transmission line. That is, the value to which this difference 15 also swung further to the delta frequency between the transmitting side and a receiver, and the part was given is shown, and, as a result, normal clock reproduction cannot be performed. Therefore, it enables it to perform clock reproduction stabilized from the difference 15 by the low pass filter and the gain 14 as cut the ingredient of fluctuation.

0011 When it passes the communication transmission lines (usually for example, satellite communication, a terrestrial wave, a cable, etc.) that the decided time slot is assigned, fluctuation is hardly produced. On the other hand, in the communication transmission line where a communication packet is transmitted irregularly, fluctuation will arise and still bigger fluctuation will arise in transmission **/ other than the above-mentioned ATM network (for example, the Internet)** .

0012

Problem to be solved by the invention It is used as what only expresses the difference in the frequency during transmission and reception of the difference of transmit-clock information (PCR) and reproduction clock information (STC) with conventional clock reproduction equipment as mentioned above, Since it was controlling by not being based on the receiving interval of transmit-clock information, but inputting into a low pass filter and a gain, when difference was equal, the same control voltage was outputted.

0013 However, since the difference of transmit-clock information and reproduction clock information is proportional to the receiving interval of transmit-clock information, when there is the same delta frequency, for example, the values of the difference outputted by what has a long transmission interval of transmit-clock information, and a short thing will differ, but. It is necessary to make the same control voltage to the oscillator for correcting the same delta frequency.

0014 Therefore, even if a delta frequency is the same, when the transmission intervals of transmit-clock

information differ and inputs (difference 15) differ, the control voltage 16 which is different when the same low pass filter and gain are used will be outputted, and it is not desirable. For this reason, corresponding to the transmission interval of transmit-clock information, SUBJECT that it was necessary to optimize occurred so that the suitable control voltage corresponding to a delta frequency might always be outputted.

0015 By fluctuation of a transmission line, if the low cut off frequency of a low pass filter is taken in order to remove the fluctuation in order that fluctuation may mix also in the difference of a clock, the flattery to the receive clock of a reproduction clock will become blunt, and normal clock reproduction will take time. Therefore, SUBJECT that it was necessary to optimize according to the quantity of fluctuation of a transmission line occurred.

0016

Means for solving problem The reproduction clock output means to which the clock reproduction equipment concerning this invention outputs a reproduction clock, The clock difference detection means which detects difference with the reproduction clock information which shows the frequency of the reproduction clock outputted from the transmit-clock information which shows a transmitting side clock frequency, and the above-mentioned reproduction clock output means, The control means which controls the reproducing clock frequency of the above-mentioned reproduction clock output means based on the above-mentioned difference from this clock difference detection means, Having an operating characteristic input means which inputs control action characteristic information to this control means, based on the control action characteristic information inputted from this operating characteristic input means, the above-mentioned control means controls the reproducing clock frequency of the above-mentioned reproduction clock output means.

0017 While having a fluctuation information setting means which the above-mentioned operating characteristic input means sets up the fluctuation information added to the above-mentioned difference, and outputs as control action characteristic information, the above-mentioned control means controls a reproducing clock frequency based on the fluctuation information set up by this fluctuation information setting means.

0018 The above-mentioned control means is provided with the gain means which generates the control signal to the above-mentioned reproduction clock output means based on the inputted above-mentioned difference, Based on the fluctuation information set up by the above-mentioned fluctuation information setting means, when fluctuation is small, the gain in the above-mentioned gain means is enlarged, and when fluctuation is large, it is made to make a gain small.

0019 The above-mentioned control means is provided with the low pass filter processing means which takes out the inputted low frequency components of the above-mentioned difference, Based on the fluctuation information set up by the above-mentioned fluctuation information setting means, when fluctuation is small, the cut off frequency of the above-mentioned low pass filter processing means is made high, and when fluctuation is large, it is made to make a cut off frequency low.

0020A fluctuation detection means to detect the size of fluctuation and to set up as fluctuation information is formed by **of the rate of a temporal change of the difference outputted from the above-mentioned clock difference detection means** computing the rate of change further.

0021 While the above-mentioned operating characteristic input means is provided with a reproduction clock state setting-out means to set up that the above-mentioned reproduction clock is a stable state, The above-mentioned control means controls a reproducing clock frequency based on the state of the reproduction clock set as this reproduction clock stable state setting-out means.

0022 The above-mentioned control means is provided with the low pass filter processing means which takes out the inputted low frequency components of the above-mentioned difference, When it is set up by the above-mentioned reproduction clock state setting-out means that a reproduction clock is a stable state, it is made to make low the cut off frequency of the above-mentioned low pass filter processing means.

0023 The rate of a temporal change of the difference outputted from the above-mentioned clock difference detection means is detected as the above-mentioned clock status setting-out means, and when this rate of a temporal change became smaller than a predetermined value, a difference rate-of-change detection means to set up that the above-mentioned reproduction clock is a stable state was formed.

0024 Having a fluctuation information setting means which the above-mentioned operating characteristic input means sets up the fluctuation information added to the above-mentioned difference, and outputs as control action characteristic information, the above-mentioned difference rate-of-change detection means sets up the above-mentioned predetermined value based on the fluctuation information set up by this fluctuation information setting means.

0025 Having a receiving interval setting-out means which the above-mentioned operating characteristic input means sets up the interval which receives the above-mentioned transmit-clock information, and outputs as control action characteristic information, the above-mentioned control means controls a reproducing clock frequency based on the receiving interval set up by this receiving interval setting-out means.

0026 The above-mentioned control means is provided with the gain means which generates the control signal to the above-mentioned reproduction clock output means based on the inputted above-mentioned difference, When the receiving interval set up by the above-mentioned receiving interval setting-out means is small, the gain in the above-mentioned gain means is enlarged, and when the above-mentioned receiving interval is large, it is made to make a gain small.

0027A receiving interval detection means to detect the interval which receives the above-mentioned transmit-clock information, and to set up as the above-mentioned receiving interval is formed.

0028 The clock reproduction method concerning this invention detects difference with the reproduction clock

information which shows the frequency of the transmit-clock information and reproduction clock in which a transmitting side clock frequency is shown, and controls the above-mentioned reproducing clock frequency based on the fluctuation information set to this detected difference.

0029 The another clock reproduction method concerning this invention, Difference with the reproduction clock information which shows the frequency of the transmit-clock information and reproduction clock in which a transmitting side clock frequency is shown is detected, and the above-mentioned reproducing clock frequency is controlled based on the state of the reproduction clock set to this detected difference.

0030 The another clock reproduction method concerning this invention detects difference with the reproduction clock information which shows the frequency of the transmit-clock information and reproduction clock in which a transmitting side clock frequency is shown, and controls the above-mentioned reproducing clock frequency based on the receiving interval set to this detected difference.

0031

Mode for carrying out the invention

Embodiment 1. drawing 1 is a block diagram showing Embodiment 1 of the clock reproduction equipment in this invention. The oscillator as a reproduction clock output means in which 1 outputs a reproduction clock, and 2 are counters which operate with the reproduction clock from this oscillator 1, and output that counted value as the reproduction clock 101. Since the counter 2 operates with the reproduction clock of the oscillator 1, this reproduction clock information 101 is information which shows that frequency.

00323 is a subtractor as a transmit-clock information receiving means and a clock difference detection means, and it detects and outputs the difference 102 of the received transmit-clock information 100 and the reproduction clock information 101 outputted from the above-mentioned counter 2 while it receives the transmit-clock information 100.

00334 is a control means which outputs the control signal 104 which controls the reproduction clock of the above-mentioned oscillator 1 based on the difference 102 from this subtractor 3. 5 is an operating characteristic input means for inputting / setting up the information which starts the control action characteristic to the above-mentioned control means 4.

0034 Next, operation is explained. When starting reproduction of a clock in this clock reproduction equipment, the transmit-clock information 100 first inputted into the subtractor 3 is loaded to the counter 2. The flag which is a predetermined bit in the signal wire in which the transmit-clock information 100 is transmitted, or a time series may detect arrival of the transmit-clock information as timing of this loading, and it may be made to tell it with the signal wire (not shown) in which arrival is shown.

0035 The value of the loaded counter 2 is outputted to the subtractor 3 as the reproduction clock information 101 (this time reproduction-clock-information 101= transmit-clock information 100). The counter 2 is started from this loaded value, and advances count operation with the reproduction clock from the oscillator 1. If the 2nd transmit-clock information 100 arrives, difference will be taken in the subtractor 3 and, as for the transmit-clock information 100 and reproduction clock information 101 from the above-mentioned counter 2, the difference 102 will be outputted as difference of the information which show the clock frequency by the side of the transmitting side and reproduction.

0036 The input of the information which starts the operating characteristic to the control means 4 is possible for the operating characteristic input means 5, and the information is set as the control means 4. In the control means 4, the control signal 104 over the oscillator 1 is generated from the difference 102 based on the operating characteristic set up from this operating characteristic input means 5. The clock information difference 102 is held in the control means 4.

0037 Although various methods can be considered about generation of the control signal 104 generated by the control means 4, In this invention, based on the control action characteristic information 105 inputted from the operating characteristic input means 5, the control means 4 generates the control signal 104, and control which can reproduce the clock of the oscillator 1 the optimal is performed.

0038 Here, the case where this control means 4 is constituted by the function of a low pass filter and a gain is explained. Drawing 2 is a block diagram showing the example of composition of the control means 4 in such a case. 21 is a low pass filter as a low pass filter processing means which takes out low frequency components from the difference 102. This low pass filter 21 may be constituted from a H/W circuit, and may consist of S/W. And what there should just be a function which takes out a low-frequency component functionally, for example, takes the arithmetical average of the difference 102, the thing which carries out a weighting and takes an average, etc. should just level a steep change of the difference 102.

003922 is a gain means which amplifies the difference 102 through the above-mentioned low pass filter 21, and generates the control signal 104 to the oscillator 1. 23 is a coefficient set part which sets up the coefficient of performance to the low pass filter 21 and the gain means 22 based on the control action characteristic information 105 from the operating characteristic input means 5.

0040 The operation which generates the control signal 104 from the difference 102 in such a control means 4, It is the same as usual fundamentally, and the control signal (voltage) which adjusts the frequency of the oscillator 1 so that the difference may be fixed (difference's becomes fixed if the frequency of the transmitting side and a receiver is the same) corresponding to the difference 102 is generated. For example, if it seems that it is small and count-up of the reproduction clock has become rapidly large to the transmit clock in the difference 102, Voltage whose difference 102 increases and which is carried out proportionally **way** and outputted to an oscillator is enlarged, the frequency of an oscillator is raised, and the frequency of a reproduction clock is made to approach the frequency of a transmit clock. In the state (the frequency of a reproduction clock and a transmit

clock is the same) where the difference 102 is stable, the gain means 22 will amplify the signal from the low pass filter 21 on the fixed gain.

0041 The function of the low pass filter 21 is explained here. Drawing 3 is also that the frequency characteristic of the low pass filter 21 is shown. The low pass filter 21 is making a cut off frequency low, and omits the signal of high frequency. That is, since a steep time change of the difference 102 is leveled and outputted, it does not follow in footsteps of early change of an input (difference 102) of the output signal sensitively one by one, and even when an output signal changes corresponding to an input, the temporal response serves as a gently-sloping curve. Since it will follow in footsteps to an early change of an input (difference 102) sensitively while it becomes impossible to cut the noise of high frequency, etc. in order to seldom omit the signal of high frequency if a cut off frequency is made high, when an output signal changes corresponding to an input, the output signal can take a steep curve.

0042 This low pass filter 21 has an effect which removes the error included in the difference 102 resulting from the fluctuation generated in the transmission line which exists between transceiving equipment. The control signal 104 becomes gently-sloping, and although a transmission line swings, a reproduction clock stops swinging not much by taking the small cut off frequency of the low pass filter 21, when fluctuation of a transmission line is large. It is taking the large cut off frequency of a low pass filter, when fluctuation of a transmission line is small, and the control signal 104 becomes possible **taking a steep value** , and a reproduction clock makes it possible to follow a transmit clock quickly.

0043 As mentioned above, since the low pass filter 21 does not have a steep change attached to the control signal 104 for controlling a reproduction clock so that it may synchronize with a transmit clock, since it is what makes the temporal response of the difference 102 gently-sloping, in order to synchronize a clock, it takes time. Therefore, also in the operation for establishing a synchronous state, it is desirable to take the large cut off frequency of a low pass filter, to change the control signal 104 steeply, and to make it a reproduction clock follow a transmit clock quickly.

0044 As mentioned above, by setting up the operating characteristic (cut off frequency) of the low pass filter 21 according to various situations, such as a situation of fluctuation of a transmission line, and status of synchronous operation, Suitable reproduction clock control according to a situation can be performed, and it enables it to set up the cut off frequency of such a low pass filter 21 as the control action characteristic information 105 from the operating characteristic input means 5 in this invention.

0045 Next, the function of the gain means 22 is explained. Usually, increase/reduction frequency of the oscillator 1 is proportional to the control signal 104 mostly. Therefore, what is necessary is just to give the control signal increased / decreased by the delta frequency to a reproduction clock, if the delta frequency of a transmit clock and a reproduction clock is known.

0046 Drawing 4 is an explanatory view showing the temporal response of a delta frequency, and it is meant that the condition of the change changes with size of a gain. Since a frequency change will become large if a gain is enlarged, it becomes possible to approach desired frequency for a short time. However, if a gain is enlarged too much, in order to change frequency beyond a delta frequency, an oscillation cuts. It will emit, if a gain is furthermore enlarged. Since a frequency change will become small if a gain is made small, after the reproduction clock has synchronized with the transmit clock mostly, a reproduction clock can be kept stable, for example, it can suppress following fluctuation of an above-mentioned transmission line, and changing. However, if a gain is made small too much, that a clock synchronizes will take time.

0047 As mentioned above, by setting up the operating characteristic (gain) of the gain means 22 according to various situations, such as a situation of fluctuation of a transmission line, and status of synchronous operation, Suitable reproduction clock control according to a situation can be performed, and it enables it to set up the operating characteristic (gain) of such a gain means 22 as the control action characteristic information 105 from the operating characteristic input means 5 in this invention.

0048 Although the case where the characteristic of the low pass filter 21 in the control means 4 or the gain means 22 could be changed was explained, When the characteristic of those functions cannot be changed easily, the same effect can be acquired by preparing two or more low pass filters and gains with the different characteristic, and using it, choosing the low pass filter and gain which have the optimal characteristic by a selector etc.

0049 In such clock reproduction, software may realize all or a part of generation of a control signal to the oscillator 1. Drawing 5 is a flow chart which shows such a case.

0050 At Step S1, transmit-clock information is received first. The transmit-clock information received first is loaded to the counter which operates with a reproduction clock. In Step S2, while detecting clock difference information from the counter value (reproduction clock information) which operates with the transmit-clock information and reproduction clock which were received, it memorizes. In Step S3, control action characteristic information is read and it is considered as the characteristic (for example, a low pass filter and the characteristic of a gain) of future control information generate times.

0051 In step S4, control of a reproduction clock is generated based on the clock information difference called for at Step S2. For example, control information is generated by applying a low pass filter to clock information difference in the low pass filter characteristic set up at Step S3, and applying the gain similarly set as the value as mentioned above. And a reproducing clock frequency is controlled by Step S5 by the control information searched for by step S4. Such operation is repeatedly performed, whenever it receives transmit-clock information, and a clock is reproduced.

0052 The case where it has a fluctuation information setting means to set up the information on the fluctuation

which exists in a transmission line as an example of composition of the embodiment 2. operating characteristic input means 5 is explained. As mentioned above, it is desirable to obtain the reproduction clock stabilized without having suppressed the influence effectively by the low pass filter 21, or having set up the gain appropriately, having followed fluctuation of a transmission line, and changing to the fluctuation which exists in a transmission line.

0053 For this reason, corresponding to the size of fluctuation, it is made to perform reproduction clock control by the control means 4 by inputting the control action characteristic information 105 which took into consideration the size of fluctuation of the transmission line from the operating characteristic input means 5. Drawing 6 is a block diagram at the time of swinging to the operating characteristic input means 5, and having the information setting means 51. Next, the size of fluctuation explains the case where the gain of the gain means 22 of drawing 2 is adjusted.

0054 Fluctuation of a transmission line is measured a priori, and is set as the fluctuation information setting means 51. In the operating characteristic input means 5, based on the fluctuation set as the fluctuation information setting means 51, when fluctuation is large, a gain is made small, and when fluctuation is small, the control action characteristic information 105 which enlarges a gain is sent to the control means 4. When fluctuation is large, clock reproduction which came out of and carried out stable by making a gain small can be performed, and when fluctuation is small, it enables it to take the synchronization of a clock in short time by enlarging a gain.

0055 The size of fluctuation explains the case where the cut off frequency of the low pass filter 21 of drawing 2 is adjusted. The low pass filter 21 has an effect which removes the error included in the difference 102 resulting from the fluctuation generated in the transmission line which exists between transceiving equipment as mentioned above. In the operating characteristic input means 5, based on the fluctuation set as the fluctuation information setting means 51, when it is small in a cut off frequency when fluctuation is large, and fluctuation is small, the control action characteristic information 105 which enlarges a cut off frequency is sent to the control means 4.

0056 When fluctuation of a transmission line is large, the control signal 104 becomes gently-sloping by taking the small cut off frequency of the low pass filter 21, as a result although a transmission line swings, a reproduction clock stops swinging not much. When fluctuation of a transmission line is small, it is taking the large cut off frequency of a low pass filter, and the control signal 104 becomes possible **taking a steep value** , and a reproduction clock makes it possible to follow a transmit clock quickly.

0057 Although the above explained the case where fluctuation information was set up beforehand, the case where fluctuation is detected next is explained. Drawing 7 is a block diagram at the time of equipping the operating characteristic input means 5 with a fluctuation detection means 52 to detect the size of fluctuation from the difference 102. Next, operation is explained. It swings and the difference 102 outputted from the subtractor 3 is inputted into the detection means 52. In the fluctuation detection means 52, fluctuation is detected from that of the difference 102 inputted. Since fluctuation (error) is included also in difference information when fluctuation is included in the transmission line as described previously, the size of fluctuation can be recognized using this.

0058 If reproduction of a clock is performed in the state where there is no fluctuation in a transmission line, as a result of the clock reproduction operation by the control means 4, a time change of the past difference will move toward a certain difference value gently-sloping, and will maintain constant value in the state where it was stabilized (lock). However, when a transmission line has fluctuation, a time change of difference moves toward a certain difference value, while the width resulting from fluctuation strikes a wave. The portion which has struck this wave is a portion related to fluctuation of a transmission line.

0059 Drawing 8 (a) is an explanatory view showing an example of the temporal change of the difference 102 in case fluctuation exists in a transmission line. It is the difference which was expressed with the point, and although what connected this difference information by the smooth curve is shown in a figure, it is a curve expected that difference in case fluctuation of a transmission line does not have this changes in time. The distance of this curve and the actual value (point of a figure) of difference is so large that fluctuation is large. It is because the error of difference is also large, so distance will separate if fluctuation is large. A curve is drawn from the difference which received and it can be begun from a difference with actual difference to draw the size of fluctuation of a transmission line.

0060 The cut off frequency of the low pass filter 21 and the gain of the gain means 22 are controllable as mentioned above using the size of the drawn fluctuation. When a transmission line state changes or a receiving set is connected to a different transmission line by this, even if the size of fluctuation changes, optimal clock reproduction control by the control means 4 can be performed automatically.

0061 The example which detects the size of fluctuation by the above-mentioned fluctuation information setting means 52 is explained below. Drawing 9 is a block diagram in this case, and is provided with a difference rate-of-change detection means 53 to detect the rate of a temporal response of the difference 102 for the fluctuation detection means 52. This difference rate-of-change detection means 53 asks for the rate of a temporal change of the difference 102 (difference is differentiated from a time-axis). Drawing 8 (b) is an explanatory view showing an example of change of the rate of a temporal change of difference, and a point is a rate of change of difference. When there is no fluctuation of a transmission line, the rate of a temporal change of difference approaches 0 gently-sloping, as shown in the curve of a figure. That is, change of difference is lost and it becomes a certain constant value. However, when fluctuation of a transmission line exists, there is always change of difference, and difference does not converge the rate of change of difference, either. Although the rate

of change of difference approaches 0, only the part of fluctuation will always be gone up and down focusing on 0.

0062 Based on the rate of a temporal change of this difference, further, it swings and that rate of change is searched for in the detection means 52. When there is fluctuation, if it is in the state which was stabilized mostly as for the reproduction clock, the result (rate of change of the rate of a temporal change of difference) will say the value of the plus over 0, and minus, or will come. (In the example of drawing 8 (b), since an increase and reduction have become by turns, the change direction of the rate of change of difference will repeat the value of plus and minus of that rate of change by turns) When the width of change of the rate of a temporal change of this difference is wavy, it can be used as a size of fluctuation. That is, even when there is no fluctuation in a transmission line, in order to reproduce a clock, there is change of a certain amount of difference, but when there is fluctuation, a big change which is a grade which the mark of the rate of a temporal change of difference reverses should occur, and this is used as fluctuation. Thereby, optimal reproduction clock control can be performed automatically.
0063 The case where it has a reproduction clock state setting-out means to set up that a reproduction clock is a stable state as an example of composition of embodiment 3., next the operating characteristic input means 5 is explained. Drawing 10 is a block diagram at the time of equipping the operating characteristic input means 5 with the reproduction clock state setting-out means 54. Usually, clock reproduction control is divided into the control for setting a clock, and the control for performing clock reproduction (it does not swing) stable (locking) from a clock suiting. It is required to improve the flattery nature of a reproduction clock to a transmit clock, in order to set a clock quickly, and in order to perform stable clock reproduction, what the rate of a temporal change of a clock is made small for (flattery nature is worsened) can attain.
0064 For this reason, corresponding to the state of a reproduction clock, it is made to perform reproduction clock control by the control means 4 by inputting the control action characteristic information 105 in consideration of whether it is in the state which the reproduction clock locked from the operating characteristic input means 5.
0065 If predetermined time passes, for example after operation of a receiving set and setting out of a state of a reproduction clock can be assumed that a reproduction clock is a locked position, It is possible to form a means to input a timer which clocks lapsed time, and its predetermined time, as the reproduction clock state setting-out means 54, and to set up beforehand. A state of a reproduction clock can also be detected and set up dynamically mention later. In the reproduction clock state setting-out means 54, if it is set up that a reproduction clock locked, the operating characteristic input means 5 will send the control action characteristic information 105 which takes the small number of cut off frequencies of the low pass filter 21 to the control means 4. thereby -- the control signal 104 -- it is gently-sloping (change is small) -- a stable clock is renewable. On the contrary, before a clock locks, it is making it take a large cut off frequency of a low pass filter, and flattery of a reproduction clock to a transmit clock to receive becomes good.
0066 As mentioned above, what a clock locked is detected and stable clock reproduction (there is little fluctuation) can be realized by making low a cut off frequency of a low pass filter within a control means after it.
0067 Next, a case where a state of a reproduction clock is dynamically detected from the difference 102 is explained. Drawing 11 is a block diagram at the time of having a difference rate-of-change detection means 55 to detect the rate of a temporal response from the difference 102, as a reproduction clock state setting-out means with which the operating characteristic input means 5 is equipped. This difference rate-of-change detection means 55 is the same as the difference rate-of-change detection means 53 formed in order to detect a size of fluctuation explained by drawing 9.
0068 The difference 102 first outputted from the subtractor 3 is inputted into the difference rate-of-change detection means 55. The temporal change of the difference 102 inputted is detected in the difference rate-of-change detection means 55. The example of the temporal change of the difference 102 is a thing as shown in drawing 8 (a), and the rate of a temporal change of difference becomes like drawing 8 (b). When the change of a temporal change of this time difference, i.e., the rate of difference, is settled in a fixed range, by the difference rate-of-change detection means 55, it considers that the clock locked and sets up that it is in the state which was stabilized as for the reproduction clock. Change in a fixed range can be presumed to be what is depended on fluctuation of a transmission line.
0069 And if it is set up that it is in the state which was stabilized as for the reproduction clock, the operating characteristic input means 5 will send the control action characteristic information 105 which takes the small cut off frequency of the low pass filter 21 to the control means 4. thereby -- the control signal 104 -- it is gently-sloping (change is small) -- the stable clock is renewable.
0070 As mentioned above, according to the state of a reproduction clock, suitable clock reproduction control by the control means 4 can be performed automatically.
0071the case where use the rate of a temporal change of difference information in this embodiment when **which the clock locked** it is rich and makes, but fluctuation is included in the transmission line -- difference information -- swinging (error) -- it is contained. Although the rate of a temporal change of difference information will also swing, it may become impossible as a result, to consider that the clock locked without becoming below a value that has a rate of a temporal change of this difference depending on the size of fluctuation of a transmission line. By forming further the fluctuation information setting means 51 which was explained by drawing 6 or drawing 9 in the operating characteristic input means 5 as an example which solves this, and outputting the fluctuation information to the difference rate-of-change detection means 55, Being able to set up the standard of the size of the temporal change of the difference for judging what the clock locked in the difference rate-of-change detection means 55, drawing 12 is a block diagram showing such composition.

0072 By the difference rate-of-change detection means 55, what the size of the temporal change of the difference which judges what the clock locked was optimized from fluctuation of the transmission line which swung and was set as the information setting means 51, and the clock locked it for can be recognized correctly. Although various relation of recognition between fluctuation of a transmission line and the lock of a clock is considered, For example, in the identification method of the lock of the clock consider that locked the case where it was below the value A with the difference of the difference information of last time and this time. The lock of the clock corresponding to fluctuation can be recognized by enlarging a certain value A, when fluctuation of a transmission line is large, and making a certain value A small, when fluctuation is small.
0073 When swinging in order to recognize correctly what the clock locked in this way, and using information, the fluctuation information can be searched for with the composition of drawing 12 using a method which was explained by drawing 9. It is because the size of fluctuation is called for by searching for a rate of change further from the difference rate of change detected by the difference rate-of-change detection means 55 as drawing 9 explained. In this case, a difference rate of change is first detected by the difference rate-of-change detection means 55, it is sent to the fluctuation information setting means 51, and the size of fluctuation is called for by searching for that rate of change further here. And the size of the called-for fluctuation is returned to the difference rate-of-change detection means 55, and it is used for lock judgment of a clock. It may constitute so that even generation of the size of fluctuation from detection of a difference rate of change may be performed within the difference rate-of-change detection means 55.
0074 When controlling according to a state of the above reproduction clocks, software may realize to **all or a part of** generation of the control signal 104 from detection of a state of a reproduction clock to the oscillator 1. Drawing 13 is a flow chart in a case of processing from detection of a difference rate of change to directions of a cut off frequency of the low pass filter 21 as control action characteristic information as this example.
0075 At Step S10, clock information difference is received first. The above-mentioned difference information is accumulated in Step S11. The number of difference information to accumulate is deleted from an old thing, when making it limited. In Step S12, a temporal response of difference information is detected as compared with this difference information and difference information accumulated before. a case where it is smaller than a value which has a difference of difference information of last time and this time in an easy example although a detecting method of a temporal response exists **that it is various and** -- a temporal change -- it is few (a rate of a temporal change: smallness) -- it carries out and a temporal change enlarges a case where it is larger than a certain value.
0076 In Step S13, it branches to the size of the temporal change of clock information difference information called for at Step S12. When a temporal change is large, nothing is done but this processing is ended. When a temporal change is small, it branches to Step S14. In Step S14, directions which make low the cut off frequency of a low pass filter are created, and it outputs to an operating characteristic input means. Such operation is repeatedly performed, whenever it receives difference information, and the characteristic applied to reproduction in a clock is controlled.
0077 The case where it has a receiving interval setting-out means to set up the interval which receives transmit-clock information as an example of composition of embodiment 3., next the operating characteristic input means 5 is explained. Although the control means 4 inputs the difference 102 of the transmit-clock information (PCR) 100 and the reproduction clock information (STC) 101 outputted from the counter 2 and is controlling the oscillator 1 in the conventional thing based on this, For example, the size of this difference 102 will change with intervals which receive PCR100 which is the count information of a transmit clock to the delta frequency which is between transmission and reception and exists. Therefore, if the receiving interval of ****** **from which the receiving interval of PCR100 differs** for systems, and PCR100 changes, it will be necessary to change the characteristic of a low pass filter or a gain corresponding to it.
0078 Then, it enables it to perform proper clock reproduction by the control means 4 at this embodiment by setting up the receiving interval of a transmit clock from the operating characteristic input means 5. Drawing 14 is a block diagram at the time of equipping the operating characteristic input means 5 with the receiving interval setting-out means 56. Next, the size of fluctuation explains the case where the gain of the gain means 22 is adjusted. A receiving interval is decided according to the specification of the system applied, and is suitably set as the receiving interval setting-out means 56.
0079 In the operating characteristic input means 5, based on the receiving interval set as the receiving interval setting-out means 56, control action characteristic information is given to the control means 4 so that the gain of the gain means 22 may be in inverse proportion to a receiving interval. that is, it coming out to the same delta frequency, and, since the value of the difference 102 will become large if a receiving interval is large, and the value of the difference 102 will become small if a receiving interval is small even if it is, For example, it enables it to output the control signal 104 which is the corresponding output as a suitable value because a value makes a gain small to the difference value which has become large because a receiving interval is large.
0080 The case where a receiving interval is detected dynamically is explained. Drawing 15 is a block diagram at the time of having a receiving interval detection means 57 to detect a receiving interval from the receiving timing of PCR100. PCR100 is inputted into this receiving interval detection means 57, that receiving interval is detected using an internal timer etc., and it is set as the receiving interval setting-out means 56.
0081 As an input, if the transmit-clock information 100 is inputted into the receiving interval detection means 7, it will record the time which received the transmit-clock information by the receiving interval detection means 7 using an internal timer etc. And a difference with the time which recorded the recorded time last time at the time of transmit-clock information reception is taken, and a receiving interval is computed.

0082 It inputs into the receiving interval setting-out means 56 by making the value which took one or a some times average for the computed receiving interval into receiving interval information. This detects the receiving interval of transmit-clock information automatically, and suitable clock reproduction control can be automatically performed by using this for the gain control of the gain means 22 as mentioned above.
0083 Software may realize all or a part of such receiving interval detecting operation. Drawing 16 is a flow chart which shows such a case.
0084 At Step S21, transmit-clock information is received first. In Step S22, the receipt time of the above-mentioned transmit-clock information is measured with a timer etc., and is saved. In Step S23, a receiving interval is computed from the difference of this receipt time and the receipt time of transmit-clock information which received before. Receiving interval information is generated in Step S24. Although the generation method of receiving interval information exists **that it is various and** , in an easy example, there are the method of making what took the some times average of the receiving interval receiving interval information, etc. In Step S25, the computed receiving interval information is outputted to an operating characteristic input means. Thus, the receiving interval of transmit-clock information is detected automatically, and suitable clock reproduction control is automatically performed by using for control of the gain of ******.
0085 Although an embodiment of all above explained a case where the characteristic of the low pass filter 21 or the gain means 22 was changed in the control means 4, It is applicable to all the embodiments to acquire same effect by preparing two or more low pass filters and gains with the different characteristic, and using it, choosing a low pass filter and a gain which have the optimal characteristic by a selector etc.
0086
Effect of the Invention Since it has an operating characteristic input means which inputs control action characteristic information to a control means and the control means controlled the reproducing clock frequency of the reproduction clock output means based on this control action characteristic information according to this invention as mentioned above, The effect that optimal clock reproduction control can be performed corresponding to various situations is done so.
0087 While having a fluctuation information setting means to set up the fluctuation information added to difference and to output as control action characteristic information, Since the control means controlled the reproducing clock frequency based on this fluctuation information, the effect that suitable clock reproduction control according to the size of fluctuation of the transmission line can be performed is done so.
0088 Since the gain in the above-mentioned gain means was enlarged when fluctuation was small, and it was made to make a gain small based on fluctuation information when fluctuation was large, the effect that the clock in the stable clock reproduction or short time can be synchronized is done so.
0089 Since the cut off frequency of the above-mentioned low pass filter processing means was made high when fluctuation was small, and it was made to make a cut off frequency low based on fluctuation information when fluctuation was large, Although a transmission line swings, a reproduction clock stops swinging not much, and a reproduction clock does so the effect of coming to follow a transmit clock quickly.
0090 Since a fluctuation detection means to have detected the size of fluctuation and to set up as fluctuation information by **of the rate of a temporal change of the difference outputted from the above-mentioned clock difference detection means** computing the rate of change further was formed, the effect that clock reproduction control according to fluctuation can be performed automatically is done so.
0091 While having a reproduction clock state setting-out means to set up that a reproduction clock is a stable state, Since the reproducing clock frequency was controlled based on the state of this reproduction clock, the effect that suitable clock reproduction control by a control means can be performed according to the state of a reproduction clock is done so.
0092 Since it was made to make low the cut off frequency of the low pass filter processing means when it was set up by a reproduction clock state setting-out means that a reproduction clock is a stable state, it is effective in the ability to perform suitable clock control after a reproduction clock is stabilized.
0093 Since a difference rate-of-change detection means to set up that a reproduction clock is a stable state when the rate of a temporal change of the difference outputted from a clock difference detection means was detected and this rate of a temporal change became smaller than a predetermined value was formed, A clock does so automatically the effect that suitable clock reproduction control based on a stable state can be performed.
0094 Since the stable state of the reproduction clock was set up based on fluctuation information, the effect that the stable state of the suitable reproduction clock according to the size of fluctuation can be judged is done so.
0095 Since it has a receiving interval setting-out means to set up the interval which receives transmit-clock information and to output as control action characteristic information and the control means controlled the reproducing clock frequency based on the receiving interval, The effect that always suitable clock reproduction control can be performed is done so irrespective of the size of a receiving interval.
0096 Since the gain in the above-mentioned gain means was enlarged when a receiving interval was small, and it was made to make a gain small when the above-mentioned receiving interval was large, the effect that suitable clock reproduction control according to a receiving interval can be performed is done so.
0097 Since a receiving interval detection means to have detected the interval which receives transmit-clock information and to set up as the above-mentioned receiving interval was formed, the effect that suitable clock reproduction control according to a receiving interval can be performed automatically is done so.
0098 According to the clock reproduction method concerning this invention, detect difference with the reproduction clock information which shows the frequency of the transmit-clock information and reproduction

clock in which a transmitting side clock frequency is shown, and This detected difference, Since the above-mentioned reproducing clock frequency is controlled based on the set-up fluctuation information, the effect that clock reproduction control according to fluctuation can be performed is done so.

0099 Detect difference with the reproduction clock information which shows the frequency of the transmit-clock information and reproduction clock in which a transmitting side clock frequency is shown, and This detected difference, Since the above-mentioned reproducing clock frequency is controlled based on the state of the set-up reproduction clock, a clock does so the effect that suitable clock reproduction control based on a stable state can be performed.

0100 Since the above-mentioned reproducing clock frequency is controlled based on the receiving interval which detected difference with the reproduction clock information which shows the frequency of the transmit-clock information and reproduction clock in which a transmitting side clock frequency is shown, and was set to this detected difference, The effect that suitable clock reproduction control according to a receiving interval can be performed is done so.

Field of the Invention In the equipment which performs communication and broadcast, this invention relates to the clock reproduction method which reproduces the clock of the transmitting side by a receiver using the clock information sent out from the transmitting side.

Description of the Prior Art Drawing 17 For example, an ITU-T white book, Are a block diagram showing conventional clock reproduction equipment as shown in advice H.222.0 (182 pages - 184 pages) of audio-visual one / multimedia related (H series) advice collection (Heisei 7(1995) February 18 ITU Association of Japan issue), and 11 in a figure A voltage controlled oscillator, A subtractor and 14 are a low pass filter and a gain the counter which operates with the reproduction clock with which 12 is outputted from this voltage oscillator 11, and 13.

0003 The clock information sent out from the transmitting side in the above-mentioned advice PCR (program clock reference), The clock information reproduced by a receiver is called STC (system time clock), and the counter value of the counter which operates with the clock which uses PCR at the transmitting side, and STC are the counter values of the above-mentioned counter 12 which operates with the clock reproduced by the receiver. The difference of PCR and STC which are asked for 15 with the above-mentioned subtractor 13, and 16 are control voltage outputted to the above-mentioned voltage controlled oscillator 11 from a low pass filter and the gain 14.

0004 Next, operation is explained. When reproducing the clock of the transmitting side in a receiver, the transmit-clock information (PCR) 100 which arrived first is loaded to the counter 12. The counter 12 performs count operation with the reproduction clock which the voltage controlled oscillator 11 outputs. Here, if the 2nd PCR100 arrives, the reproduction clock information (STC) 101 which is an output of the counter 12 at this time will be inputted into the subtractor 13, and the difference 15 of the 2nd PCR100 that arrived will be called for.

0005 Since PCR100 is a value of the counter which operates with the clock of a sending set and STC101 is a value of the counter which operates with the clock of a receiving set, the difference of PCR100 and STC101 shows the quantity resulting from the difference of the frequency between the clock of a sending set, and the clock of a receiving set. For example, if the clock frequency of a sending set is higher than the clock frequency of a receiving set 20 Hz, the increment of the counted value of PCR100 will serve as a large value 20 from the increment of the counted value of STC101 in 1 second. Therefore, if the difference 10 of PCR100 and STC101 is the same value in last time and this time, since the number counted in same time is the same, frequency is that it is the same.

0006 If it becomes the same whenever it arrives, it is shown **this difference of whose is PCR100** that the progress condition of the counter became the same, i.e., transmitting side frequency and reproduction frequency are the same. The quantity from which the difference 15 outputted from the subtractor 13 is changed into the control voltage 16 on a low pass filter and the gain 14, the frequency of the voltage controlled oscillator 11 changes, the output of the counter 12 changes in connection with it, and the difference of PCR100 and STC101 changes decreases gradually.

0007 So that the above-mentioned operation may be repeated whenever PCR100 arrives, and it may become fixed outputting (difference of PCR100 and STC101) of the subtractor 13, That is, by controlling the frequency of the voltage controlled oscillator 13 so that the value counted up in same time becomes equal to the transmitting side, clock reproduction of the same frequency as the transmitting side is performed.

0008 The clock reproduction of the same frequency as the transmitting side is made, and the difference of PCR100 and STC101 usually maintains constant value (offset) in the state of being stable. Since this loads PCR100 to the counter 12 at first, there is no offset at this time, but since it is before the reproduction motion of transmitting side frequency, Transmitting side frequency and reproduction frequency have shifted and it is because PCR100 and a counter value will have offset in the state where it was stabilized since reproduction frequency was controlled so that it shifts gradually and difference becomes fixed in connection with reproduction motion.

0009 If transmission of data is simultaneously required from two or more equipment when carrying out multiplex

transmission of the data of two or more communication apparatus, for example in the network of ATM (Asynchronous Transfer Mode), if a network is used when communicating, In a network, since it cannot transmit simultaneously, those data is transmitted one by one. The send data of a transmit terminal remains in a network temporarily by this, and the interval of transmission of the data transmitted from a sending set is no longer held with a receiving terminal. Such a situation is said that a transmission line (network) has fluctuation.

0010 When fluctuation exists in a transmission line, the receiving timing of PCR will also swing and the difference 15 will stop thus, expressing the difference of the clock frequency of the transmitting side and a receiver with the influence of fluctuation of the receiving timing of this PCR correctly by fluctuation of a transmission line. That is, the value to which this difference 15 also swung further to the delta frequency between the transmitting side and a receiver, and the part was given is shown, and, as a result, normal clock reproduction cannot be performed. Therefore, it enables it to perform clock reproduction stabilized from the difference 15 by the low pass filter and the gain 14 as cut the ingredient of fluctuation.

0011 When it passes the communication transmission lines (usually for example, satellite communication, a terrestrial wave, a cable, etc.) that the decided time slot is assigned, fluctuation is hardly produced. On the other hand, in the communication transmission line where a communication packet is transmitted irregularly, fluctuation will arise and still bigger fluctuation will arise in transmission **/ other than the above-mentioned ATM network (for example, the Internet)** .

Effect of the Invention Since it has an operating characteristic input means which inputs control action characteristic information to a control means and the control means controlled the reproducing clock frequency of the reproduction clock output means based on this control action characteristic information according to this invention as mentioned above, The effect that optimal clock reproduction control can be performed corresponding to various situations is done so.

0087 While having a fluctuation information setting means to set up the fluctuation information added to difference and to output as control action characteristic information, Since the control means controlled the reproducing clock frequency based on this fluctuation information, the effect that suitable clock reproduction control according to the size of fluctuation of the transmission line can be performed is done so.

0088 Since the gain in the above-mentioned gain means was enlarged when fluctuation was small, and it was made to make a gain small based on fluctuation information when fluctuation was large, the effect that the clock in the stable clock reproduction or short time can be synchronized is done so.

0089 Since the cut off frequency of the above-mentioned low pass filter processing means was made high when fluctuation was small, and it was made to make a cut off frequency low based on fluctuation information when fluctuation was large, Although a transmission line swings, a reproduction clock stops swinging not much, and a reproduction clock does so the effect of coming to follow a transmit clock quickly.

0090 Since a fluctuation detection means to have detected the size of fluctuation and to set up as fluctuation information by **of the rate of a temporal change of the difference outputted from the above-mentioned clock difference detection means** computing the rate of change further was formed, the effect that clock reproduction control according to fluctuation can be performed automatically is done so.

0091 While having a reproduction clock state setting-out means to set up that a reproduction clock is a stable state, Since the reproducing clock frequency was controlled based on the state of this reproduction clock, the effect that suitable clock reproduction control by a control means can be performed according to the state of a reproduction clock is done so.

0092 Since it was made to make low the cut off frequency of the low pass filter processing means when it was set up by a reproduction clock state setting-out means that a reproduction clock is a stable state, it is effective in the ability to perform suitable clock control after a reproduction clock is stabilized.

0093 Since a difference rate-of-change detection means to set up that a reproduction clock is a stable state when the rate of a temporal change of the difference outputted from a clock difference detection means was detected and this rate of a temporal change became smaller than a predetermined value was formed, A clock does so automatically the effect that suitable clock reproduction control based on a stable state can be performed.

0094 Since the stable state of the reproduction clock was set up based on fluctuation information, the effect that the stable state of the suitable reproduction clock according to the size of fluctuation can be judged is done so.

0095 Since it has a receiving interval setting-out means to set up the interval which receives transmit-clock information and to output as control action characteristic information and the control means controlled the reproducing clock frequency based on the receiving interval, The effect that always suitable clock reproduction control can be performed is done so irrespective of the size of a receiving interval.

0096 Since the gain in the above-mentioned gain means was enlarged when a receiving interval was small, and it was made to make a gain small when the above-mentioned receiving interval was large, the effect that suitable clock reproduction control according to a receiving interval can be performed is done so.

0097 Since a receiving interval detection means to have detected the interval which receives transmit-clock information and to set up as the above-mentioned receiving interval was formed, the effect that suitable clock reproduction control according to a receiving interval can be performed automatically is done so.

0098 According to the clock reproduction method concerning this invention, detect difference with the reproduction clock information which shows the frequency of the transmit-clock information and reproduction

clock in which a transmitting side clock frequency is shown, and This detected difference, Since the above-mentioned reproducing clock frequency is controlled based on the set-up fluctuation information, the effect that clock reproduction control according to fluctuation can be performed is done so.

0099 Detect difference with the reproduction clock information which shows the frequency of the transmit-clock information and reproduction clock in which a transmitting side clock frequency is shown, and This detected difference, Since the above-mentioned reproducing clock frequency is controlled based on the state of the set-up reproduction clock, a clock does so the effect that suitable clock reproduction control based on a stable state can be performed.

0100 Since the above-mentioned reproducing clock frequency is controlled based on the receiving interval which detected difference with the reproduction clock information which shows the frequency of the transmit-clock information and reproduction clock in which a transmitting side clock frequency is shown, and was set to this detected difference, The effect that suitable clock reproduction control according to a receiving interval can be performed is done so.

Problem to be solved by the invention It is used as what only expresses the difference in the frequency during transmission and reception of the difference of transmit-clock information (PCR) and reproduction clock information (STC) with conventional clock reproduction equipment as mentioned above, Since it was controlling by not being based on the receiving interval of transmit-clock information, but inputting into a low pass filter and a gain, when difference was equal, the same control voltage was outputted.

0013 However, since the difference of transmit-clock information and reproduction clock information is proportional to the receiving interval of transmit-clock information, when there is the same delta frequency, for example, the values of the difference outputted by what has a long transmission interval of transmit-clock information, and a short thing will differ, but. It is necessary to make the same control voltage to the oscillator for correcting the same delta frequency.

0014 Therefore, even if a delta frequency is the same, when the transmission intervals of transmit-clock information differ and inputs (difference 15) differ, the control voltage 16 which is different when the same low pass filter and gain are used will be outputted, and it is not desirable. For this reason, corresponding to the transmission interval of transmit-clock information, SUBJECT that it was necessary to optimize occurred so that the suitable control voltage corresponding to a delta frequency might always be outputted.

0015 By fluctuation of a transmission line, if the low cut off frequency of a low pass filter is taken in order to remove the fluctuation in order that fluctuation may mix also in the difference of a clock, the flattery to the receive clock of a reproduction clock will become blunt, and normal clock reproduction will take time. Therefore, SUBJECT that it was necessary to optimize according to the quantity of fluctuation of a transmission line occurred.

Means for solving problem The reproduction clock output means to which the clock reproduction equipment concerning this invention outputs a reproduction clock, The clock difference detection means which detects difference with the reproduction clock information which shows the frequency of the reproduction clock outputted from the transmit-clock information which shows a transmitting side clock frequency, and the above-mentioned reproduction clock output means, The control means which controls the reproducing clock frequency of the above-mentioned reproduction clock output means based on the above-mentioned difference from this clock difference detection means, Having an operating characteristic input means which inputs control action characteristic information to this control means, based on the control action characteristic information inputted from this operating characteristic input means, the above-mentioned control means controls the reproducing clock frequency of the above-mentioned reproduction clock output means.

0017 While having a fluctuation information setting means which the above-mentioned operating characteristic input means sets up the fluctuation information added to the above-mentioned difference, and outputs as control action characteristic information, the above-mentioned control means controls a reproducing clock frequency based on the fluctuation information set up by this fluctuation information setting means.

0018 The above-mentioned control means is provided with the gain means which generates the control signal to the above-mentioned reproduction clock output means based on the inputted above-mentioned difference, Based on the fluctuation information set up by the above-mentioned fluctuation information setting means, when fluctuation is small, the gain in the above-mentioned gain means is enlarged, and when fluctuation is large, it is made to make a gain small.

0019 The above-mentioned control means is provided with the low pass filter processing means which takes out the inputted low frequency components of the above-mentioned difference, Based on the fluctuation information set up by the above-mentioned fluctuation information setting means, when fluctuation is small, the cut off frequency of the above-mentioned low pass filter processing means is made high, and when fluctuation is large, it is made to make a cut off frequency low.

0020A fluctuation detection means to detect the size of fluctuation and to set up as fluctuation information is formed by **of the rate of a temporal change of the difference outputted from the above-mentioned clock difference detection means** computing the rate of change further.

0021 While the above-mentioned operating characteristic input means is provided with a reproduction clock state setting-out means to set up that the above-mentioned reproduction clock is a stable state, The above-mentioned control means controls a reproducing clock frequency based on the state of the reproduction clock set as this reproduction clock stable state setting-out means.
0022 The above-mentioned control means is provided with the low pass filter processing means which takes out the inputted low frequency components of the above-mentioned difference, When it is set up by the above-mentioned reproduction clock state setting-out means that a reproduction clock is a stable state, it is made to make low the cut off frequency of the above-mentioned low pass filter processing means.
0023 The rate of a temporal change of the difference outputted from the above-mentioned clock difference detection means is detected as the above-mentioned clock status setting-out means, and when this rate of a temporal change became smaller than a predetermined value, a difference rate-of-change detection means to set up that the above-mentioned reproduction clock is a stable state was formed.
0024 Having a fluctuation information setting means which the above-mentioned operating characteristic input means sets up the fluctuation information added to the above-mentioned difference, and outputs as control action characteristic information, the above-mentioned difference rate-of-change detection means sets up the above-mentioned predetermined value based on the fluctuation information set up by this fluctuation information setting means.
0025 Having a receiving interval setting-out means which the above-mentioned operating characteristic input means sets up the interval which receives the above-mentioned transmit-clock information, and outputs as control action characteristic information, the above-mentioned control means controls a reproducing clock frequency based on the receiving interval set up by this receiving interval setting-out means.
0026 The above-mentioned control means is provided with the gain means which generates the control signal to the above-mentioned reproduction clock output means based on the inputted above-mentioned difference, When the receiving interval set up by the above-mentioned receiving interval setting-out means is small, the gain in the above-mentioned gain means is enlarged, and when the above-mentioned receiving interval is large, it is made to make a gain small.
0027A receiving interval detection means to detect the interval which receives the above-mentioned transmit-clock information, and to set up as the above-mentioned receiving interval is formed.
0028 The clock reproduction method concerning this invention detects difference with the reproduction clock information which shows the frequency of the transmit-clock information and reproduction clock in which a transmitting side clock frequency is shown, and controls the above-mentioned reproducing clock frequency based on the fluctuation information set to this detected difference.
0029 The another clock reproduction method concerning this invention, Difference with the reproduction clock information which shows the frequency of the transmit-clock information and reproduction clock in which a transmitting side clock frequency is shown is detected, and the above-mentioned reproducing clock frequency is controlled based on the state of the reproduction clock set to this detected difference.
0030 The another clock reproduction method concerning this invention detects difference with the reproduction clock information which shows the frequency of the transmit-clock information and reproduction clock in which a transmitting side clock frequency is shown, and controls the above-mentioned reproducing clock frequency based on the receiving interval set to this detected difference.
0031
Mode for carrying out the invention
Embodiment 1. drawing 1 is a block diagram showing Embodiment 1 of clock reproduction equipment in this invention. An oscillator as a reproduction clock output means in which 1 outputs a reproduction clock, and 2 are counters which operate with a reproduction clock from this oscillator 1, and output that counted value as the reproduction clock 101. Since the counter 2 operates with a reproduction clock of the oscillator 1, this reproduction clock information 101 is information which shows that frequency.
00323 is a subtractor as a transmit-clock information receiving means and a clock difference detection means, and it detects and outputs the difference 102 of the received transmit-clock information 100 and the reproduction clock information 101 outputted from the above-mentioned counter 2 while it receives the transmit-clock information 100.
00334 is a control means which outputs the control signal 104 which controls a reproduction clock of the above-mentioned oscillator 1 based on the difference 102 from this subtractor 3. 5 is an operating characteristic input means for inputting / setting up information which starts the control action characteristic to the above-mentioned control means 4.
0034 Next, operation is explained. When starting reproduction of a clock in this clock reproduction equipment, the transmit-clock information 100 first inputted into the subtractor 3 is loaded to the counter 2. The flag which is a predetermined bit in the signal wire in which the transmit-clock information 100 is transmitted, or a time series may detect arrival of the transmit-clock information as timing of this loading, and it may be made to tell it with the signal wire (not shown) in which arrival is shown.
0035 The value of the loaded counter 2 is outputted to the subtractor 3 as the reproduction clock information 101 (this time reproduction-clock-information 101= transmit-clock information 100). The counter 2 is started from this loaded value, and advances count operation with the reproduction clock from the oscillator 1. If the 2nd transmit-clock information 100 arrives, difference will be taken in the subtractor 3 and, as for the transmit-clock information 100 and reproduction clock information 101 from the above-mentioned counter 2, the difference 102 will be outputted as difference of the information which show the clock frequency by the side of

the transmitting side and reproduction.

0036 The input of the information which starts the operating characteristic to the control means 4 is possible for the operating characteristic input means 5, and the information is set as the control means 4. In the control means 4, the control signal 104 over the oscillator 1 is generated from the difference 102 based on the operating characteristic set up from this operating characteristic input means 5. The clock information difference 102 is held in the control means 4.

0037 Although various methods can be considered about generation of the control signal 104 generated by the control means 4, In this invention, based on the control action characteristic information 105 inputted from the operating characteristic input means 5, the control means 4 generates the control signal 104, and control which can reproduce the clock of the oscillator 1 the optimal is performed.

0038 Here, the case where this control means 4 is constituted by the function of a low pass filter and a gain is explained. Drawing 2 is a block diagram showing the example of composition of the control means 4 in such a case. 21 is a low pass filter as a low pass filter processing means which takes out low frequency components from the difference 102. This low pass filter 21 may be constituted from a H/W circuit, and may consist of S/W. And what there should just be a function which takes out a low-frequency component functionally, for example, takes the arithmetical average of the difference 102, the thing which carries out a weighting and takes an average, etc. should just level a steep change of the difference 102.

003922 is a gain means which amplifies the difference 102 through the above-mentioned low pass filter 21, and generates the control signal 104 to the oscillator 1. 23 is a coefficient set part which sets up the coefficient of performance to the low pass filter 21 and the gain means 22 based on the control action characteristic information 105 from the operating characteristic input means 5.

0040 The operation which generates the control signal 104 from the difference 102 in such a control means 4, It is the same as usual fundamentally, and the control signal (voltage) which adjusts the frequency of the oscillator 1 so that the difference may be fixed (difference's becomes fixed if the frequency of the transmitting side and a receiver is the same) corresponding to the difference 102 is generated. For example, if it seems that it is small and count-up of the reproduction clock has become rapidly large to the transmit clock in the difference 102, Voltage whose difference 102 increases and which is carried out proportionally **way** and outputted to an oscillator is enlarged, the frequency of an oscillator is raised, and the frequency of a reproduction clock is made to approach the frequency of a transmit clock. In the state (the frequency of a reproduction clock and a transmit clock is the same) where the difference 102 is stable, the gain means 22 will amplify the signal from the low pass filter 21 on the fixed gain.

0041 The function of the low pass filter 21 is explained here. Drawing 3 is also that the frequency characteristic of the low pass filter 21 is shown. The low pass filter 21 is making a cut off frequency low, and omits the signal of high frequency. That is, since a steep time change of the difference 102 is leveled and outputted, it does not follow in footsteps of early change of an input (difference 102) of the output signal sensitively one by one, and even when an output signal changes corresponding to an input, the temporal response serves as a gently-sloping curve. Since it will follow in footsteps to an early change of an input (difference 102) sensitively while it becomes impossible to cut the noise of high frequency, etc. in order to seldom omit the signal of high frequency if a cut off frequency is made high, when an output signal changes corresponding to an input, the output signal can take a steep curve.

0042 This low pass filter 21 has an effect which removes an error included in the difference 102 resulting from fluctuation generated in a transmission line which exists between transceiving equipment. The control signal 104 becomes gently-sloping, and although a transmission line swings, a reproduction clock stops swinging not much by taking a small cut off frequency of the low pass filter 21, when fluctuation of a transmission line is large. It is taking a large cut off frequency of a low pass filter, when fluctuation of a transmission line is small, and the control signal 104 becomes possible **taking a steep value** , and a reproduction clock makes it possible to follow a transmit clock quickly.

0043 As mentioned above, since the low pass filter 21 does not have a steep change attached to the control signal 104 for controlling a reproduction clock so that it may synchronize with a transmit clock, since it is what makes a temporal response of the difference 102 gently-sloping, in order to synchronize a clock, it takes time. Therefore, also in operation for establishing a synchronous state, it is desirable to take a large cut off frequency of a low pass filter, to change the control signal 104 steeply, and to make it a reproduction clock follow a transmit clock quickly.

0044 As mentioned above, by setting up the operating characteristic (cut off frequency) of the low pass filter 21 according to various situations, such as a situation of fluctuation of a transmission line, and status of synchronous operation, Suitable reproduction clock control according to a situation can be performed, and it enables it to set up a cut off frequency of such a low pass filter 21 as the control action characteristic information 105 from the operating characteristic input means 5 in this invention.

0045 Next, the function of the gain means 22 is explained. Usually, increase/reduction frequency of the oscillator 1 is proportional to the control signal 104 mostly. Therefore, what is necessary is just to give the control signal increased / decreased by the delta frequency to a reproduction clock, if the delta frequency of a transmit clock and a reproduction clock is known.

0046 Drawing 4 is an explanatory view showing the temporal response of a delta frequency, and it is meant that the condition of the change changes with size of a gain. Since a frequency change will become large if a gain is enlarged, it becomes possible to approach desired frequency for a short time. However, if a gain is enlarged too much, in order to change frequency beyond a delta frequency, an oscillation cuts. It will emit, if a gain is

furthermore enlarged. Since a frequency change will become small if a gain is made small, after the reproduction clock has synchronized with the transmit clock mostly, a reproduction clock can be kept stable, for example, it can suppress following fluctuation of an above-mentioned transmission line, and changing. However, if a gain is made small too much, that a clock synchronizes will take time.

0047 As mentioned above, by setting up the operating characteristic (gain) of the gain means 22 according to various situations, such as a situation of fluctuation of a transmission line, and status of synchronous operation, Suitable reproduction clock control according to a situation can be performed, and it enables it to set up the operating characteristic (gain) of such a gain means 22 as the control action characteristic information 105 from the operating characteristic input means 5 in this invention.

0048 Although the case where the characteristic of the low pass filter 21 in the control means 4 or the gain means 22 could be changed was explained, When the characteristic of those functions cannot be changed easily, the same effect can be acquired by preparing two or more low pass filters and gains with the different characteristic, and using it, choosing the low pass filter and gain which have the optimal characteristic by a selector etc.

0049 In such clock reproduction, software may realize all or a part of generation of a control signal to the oscillator 1. Drawing 5 is a flow chart which shows such a case.

0050 At Step S1, transmit-clock information is received first. Transmit-clock information received first is loaded to a counter which operates with a reproduction clock. In Step S2, while detecting clock difference information from a counter value (reproduction clock information) which operates with transmit-clock information and a reproduction clock which were received, it memorizes. In Step S3, control action characteristic information is read and it is considered as the characteristic (for example, a low pass filter and the characteristic of a gain) of future control information generate times.

0051 In step S4, control of a reproduction clock is generated based on clock information difference called for at Step S2. For example, control information is generated by applying a low pass filter to clock information difference in the low pass filter characteristic set up at Step S3, and applying a gain similarly set as the value as mentioned above. And a reproducing clock frequency is controlled by Step S5 by control information searched for by step S4. Such operation is repeatedly performed, whenever it receives transmit-clock information, and a clock is reproduced.

0052A case where it has a fluctuation information setting means to set up information on fluctuation which exists in a transmission line as an example of composition of the embodiment 2. operating characteristic input means 5 is explained. As mentioned above, it is desirable to obtain a reproduction clock stabilized without having suppressed the influence effectively by the low pass filter 21, or having set up a gain appropriately, having followed fluctuation of a transmission line, and changing to fluctuation which exists in a transmission line.

0053 For this reason, corresponding to the size of fluctuation, it is made to perform reproduction clock control by the control means 4 by inputting the control action characteristic information 105 which took into consideration the size of fluctuation of the transmission line from the operating characteristic input means 5. Drawing 6 is a block diagram at the time of swinging to the operating characteristic input means 5, and having the information setting means 51. Next, the size of fluctuation explains the case where the gain of the gain means 22 of drawing 2 is adjusted.

0054 Fluctuation of a transmission line is measured a priori, and is set as the fluctuation information setting means 51. In the operating characteristic input means 5, based on the fluctuation set as the fluctuation information setting means 51, when fluctuation is large, a gain is made small, and when fluctuation is small, the control action characteristic information 105 which enlarges a gain is sent to the control means 4. When fluctuation is large, clock reproduction which came out of and carried out stable by making a gain small can be performed, and when fluctuation is small, it enables it to take the synchronization of a clock in short time by enlarging a gain.

0055 The size of fluctuation explains the case where the cut off frequency of the low pass filter 21 of drawing 2 is adjusted. The low pass filter 21 has an effect which removes the error included in the difference 102 resulting from the fluctuation generated in the transmission line which exists between transceiving equipment as mentioned above. In the operating characteristic input means 5, based on the fluctuation set as the fluctuation information setting means 51, when it is small in a cut off frequency when fluctuation is large, and fluctuation is small, the control action characteristic information 105 which enlarges a cut off frequency is sent to the control means 4.

0056 When fluctuation of a transmission line is large, the control signal 104 becomes gently-sloping by taking the small cut off frequency of the low pass filter 21, as a result although a transmission line swings, a reproduction clock stops swinging not much. When fluctuation of a transmission line is small, it is taking the large cut off frequency of a low pass filter, and the control signal 104 becomes possible **taking a steep value** , and a reproduction clock makes it possible to follow a transmit clock quickly.

0057 Although the above explained the case where fluctuation information was set up beforehand, the case where fluctuation is detected next is explained. Drawing 7 is a block diagram at the time of equipping the operating characteristic input means 5 with a fluctuation detection means 52 to detect the size of fluctuation from the difference 102. Next, operation is explained. It swings and the difference 102 outputted from the subtractor 3 is inputted into the detection means 52. In the fluctuation detection means 52, fluctuation is detected from that of the difference 102 inputted. Since fluctuation (error) is included also in difference information when fluctuation is included in the transmission line as described previously, the size of fluctuation can be recognized using this.

0058 If reproduction of a clock is performed in the state where there is no fluctuation in a transmission line, as a result of the clock reproduction operation by the control means 4, a time change of the past difference will move toward a certain difference value gently-sloping, and will maintain constant value in the state where it was stabilized (lock). However, when a transmission line has fluctuation, a time change of difference moves toward a certain difference value, while the width resulting from fluctuation strikes a wave. The portion which has struck this wave is a portion related to fluctuation of a transmission line.
0059 Drawing 8 (a) is an explanatory view showing an example of the temporal change of the difference 102 in case fluctuation exists in a transmission line. It is the difference which was expressed with the point, and although what connected this difference information by the smooth curve is shown in a figure, it is a curve expected that difference in case fluctuation of a transmission line does not have this changes in time. The distance of this curve and the actual value (point of a figure) of difference is so large that fluctuation is large. It is because the error of difference is also large, so distance will separate if fluctuation is large. A curve is drawn from the difference which received and it can be begun from a difference with actual difference to draw the size of fluctuation of a transmission line.
0060 The cut off frequency of the low pass filter 21 and the gain of the gain means 22 are controllable as mentioned above using the size of the drawn fluctuation. When a transmission line state changes or a receiving set is connected to a different transmission line by this, even if the size of fluctuation changes, optimal clock reproduction control by the control means 4 can be performed automatically.
0061 The example which detects the size of fluctuation by the above-mentioned fluctuation information setting means 52 is explained below. Drawing 9 is a block diagram in this case, and is provided with a difference rate-of-change detection means 53 to detect the rate of a temporal response of the difference 102 for the fluctuation detection means 52. This difference rate-of-change detection means 53 asks for the rate of a temporal change of the difference 102 (difference is differentiated from a time-axis). Drawing 8 (b) is an explanatory view showing an example of change of the rate of a temporal change of difference, and a point is a rate of change of difference. When there is no fluctuation of a transmission line, the rate of a temporal change of difference approaches 0 gently-sloping, as shown in the curve of a figure. That is, change of difference is lost and it becomes a certain constant value. However, when fluctuation of a transmission line exists, there is always change of difference, and difference does not converge the rate of change of difference, either. Although the rate of change of difference approaches 0, only the part of fluctuation will always be gone up and down focusing on 0.

0062 Based on the rate of a temporal change of this difference, further, it swings and that rate of change is searched for in the detection means 52. When there is fluctuation, if it is in the state which was stabilized mostly as for the reproduction clock, the result (rate of change of the rate of a temporal change of difference) will say the value of the plus over 0, and minus, or will come. (In the example of drawing 8 (b), since an increase and reduction have become by turns, the change direction of the rate of change of difference will repeat the value of plus and minus of that rate of change by turns) When the width of change of the rate of a temporal change of this difference is wavy, it can be used as a size of fluctuation. That is, even when there is no fluctuation in a transmission line, in order to reproduce a clock, there is change of a certain amount of difference, but when there is fluctuation, a big change which is a grade which the mark of the rate of a temporal change of difference reverses should occur, and this is used as fluctuation. Thereby, optimal reproduction clock control can be performed automatically.
0063 The case where it has a reproduction clock state setting-out means to set up that a reproduction clock is a stable state as an example of composition of embodiment 3., next the operating characteristic input means 5 is explained. Drawing 10 is a block diagram at the time of equipping the operating characteristic input means 5 with the reproduction clock state setting-out means 54. Usually, clock reproduction control is divided into the control for setting a clock, and the control for performing clock reproduction (it does not swing) stable (locking) from a clock suiting. It is required to improve the flattery nature of a reproduction clock to a transmit clock, in order to set a clock quickly, and in order to perform stable clock reproduction, what the rate of a temporal change of a clock is made small for (flattery nature is worsened) can attain.
0064 For this reason, corresponding to the state of a reproduction clock, it is made to perform reproduction clock control by the control means 4 by inputting the control action characteristic information 105 in consideration of whether it is in the state which the reproduction clock locked from the operating characteristic input means 5.
0065 If predetermined time passes, for example after operation of a receiving set and setting out of the state of a reproduction clock can be assumed that the reproduction clock is a locked position, It is possible to form a means to input the timer which clocks lapsed time, and its predetermined time, as the reproduction clock state setting-out means 54, and to set up beforehand. The state of a reproduction clock can also be detected and set up dynamically mention later. In the reproduction clock state setting-out means 54, if it is set up that the reproduction clock locked, the operating characteristic input means 5 will send the control action characteristic information 105 which takes the small number of cut off frequencies of the low pass filter 21 to the control means 4. thereby -- the control signal 104 -- it is gently-sloping (change is small) -- the stable clock is renewable. On the contrary, before a clock locks, it is making it take the large cut off frequency of a low pass filter, and the flattery of a reproduction clock to the transmit clock to receive becomes good.
0066 As mentioned above, what the clock locked is detected and stable clock reproduction (there is little fluctuation) can be realized by making low the cut off frequency of the low pass filter within a control means after it.
0067 Next, the case where the state of a reproduction clock is dynamically detected from the difference 102 is

explained. Drawing 11 is a block diagram at the time of having a difference rate-of-change detection means 55 to detect the rate of a temporal response from the difference 102, as a reproduction clock state setting-out means with which the operating characteristic input means 5 is equipped. This difference rate-of-change detection means 55 is the same as the difference rate-of-change detection means 53 formed in order to detect the size of the fluctuation explained by drawing 9.

0068 The difference 102 first outputted from the subtractor 3 is inputted into the difference rate-of-change detection means 55. The temporal change of the difference 102 inputted is detected in the difference rate-of-change detection means 55. The example of the temporal change of the difference 102 is a thing as shown in drawing 8 (a), and the rate of a temporal change of difference becomes like drawing 8 (b). When the change of a temporal change of this time difference, i.e., the rate of difference, is settled in a fixed range, by the difference rate-of-change detection means 55, it considers that the clock locked and sets up that it is in the state which was stabilized as for the reproduction clock. Change in a fixed range can be presumed to be what is depended on fluctuation of a transmission line.

0069 And if it is set up that it is in the state which was stabilized as for the reproduction clock, the operating characteristic input means 5 will send the control action characteristic information 105 which takes the small cut off frequency of the low pass filter 21 to the control means 4. thereby -- the control signal 104 -- it is gently-sloping (change is small) -- the stable clock is renewable.

0070 As mentioned above, according to the state of a reproduction clock, suitable clock reproduction control by the control means 4 can be performed automatically.

0071the case where use the rate of a temporal change of difference information in this embodiment when **which the clock locked** it is rich and makes, but fluctuation is included in the transmission line -- difference information -- swinging (error) -- it is contained. Although the rate of a temporal change of difference information will also swing, it may become impossible as a result, to consider that the clock locked without becoming below a value that has a rate of a temporal change of this difference depending on the size of fluctuation of a transmission line. By forming further the fluctuation information setting means 51 which was explained by drawing 6 or drawing 9 in the operating characteristic input means 5 as an example which solves this, and outputting the fluctuation information to the difference rate-of-change detection means 55, Being able to set up the standard of the size of the temporal change of the difference for judging what the clock locked in the difference rate-of-change detection means 55, drawing 12 is a block diagram showing such composition.

0072 By the difference rate-of-change detection means 55, what the size of the temporal change of the difference which judges what the clock locked was optimized from fluctuation of the transmission line which swung and was set as the information setting means 51, and the clock locked it for can be recognized correctly. Although various relation of recognition between fluctuation of a transmission line and the lock of a clock is considered, For example, in the identification method of the lock of the clock consider that locked the case where it was below the value A with the difference of the difference information of last time and this time. The lock of the clock corresponding to fluctuation can be recognized by enlarging a certain value A, when fluctuation of a transmission line is large, and making a certain value A small, when fluctuation is small.

0073 When swinging in order to recognize correctly what the clock locked in this way, and using information, the fluctuation information can be searched for with the composition of drawing 12 using a method which was explained by drawing 9. It is because the size of fluctuation is called for by searching for a rate of change further from the difference rate of change detected by the difference rate-of-change detection means 55 as drawing 9 explained. In this case, a difference rate of change is first detected by the difference rate-of-change detection means 55, it is sent to the fluctuation information setting means 51, and the size of fluctuation is called for by searching for that rate of change further here. And the size of the called-for fluctuation is returned to the difference rate-of-change detection means 55, and it is used for lock judgment of a clock. It may constitute so that even generation of the size of fluctuation from detection of a difference rate of change may be performed within the difference rate-of-change detection means 55.

0074 When controlling according to the state of the above reproduction clocks, software may realize to **all or a part of** generation of the control signal 104 from detection of the state of a reproduction clock to the oscillator 1. Drawing 13 is a flow chart in the case of processing from detection of a difference rate of change to directions of the cut off frequency of the low pass filter 21 as control action characteristic information as this example.

0075 At Step S10, clock information difference is received first. The above-mentioned difference information is accumulated in Step S11. The number of the difference information to accumulate is deleted from an old thing, when making it limited. In Step S12, the temporal response of difference information is detected as compared with this difference information and the difference information accumulated before. the case where it is smaller than the value which has a difference of the difference information of last time and this time in an easy example although the detecting method of a temporal response exists **that it is various and** -- a temporal change -- it is few (the rate of a temporal change: smallness) -- it carries out and a temporal change enlarges the case where it is larger than a certain value.

0076 In Step S13, it branches to size of a temporal change of clock information difference information called for at Step S12. When a temporal change is large, nothing is done but this processing is ended. When a temporal change is small, it branches to Step S14. In Step S14, directions which make low a cut off frequency of a low pass filter are created, and it outputs to an operating characteristic input means. Such operation is repeatedly performed, whenever it receives difference information, and the characteristic applied to reproduction in a clock is controlled.

0077A case where it has a receiving interval setting-out means to set up an interval which receives transmit-

clock information as an example of composition of embodiment 3., next the operating characteristic input means 5 is explained. Although the control means 4 inputs the difference 102 of the transmit-clock information (PCR) 100 and the reproduction clock information (STC) 101 outputted from the counter 2 and is controlling the oscillator 1 in the conventional thing based on this, For example, a size of this difference 102 will change with intervals which receive PCR100 which is the count information of a transmit clock to a delta frequency which is between transmission and reception and exists. Therefore, if a receiving interval of ****** **from which a receiving interval of PCR100 differs** for systems, and PCR100 changes, it will be necessary to change the characteristic of a low pass filter or a gain corresponding to it.

0078 Then, it enables it to perform proper clock reproduction by the control means 4 at this embodiment by setting up the receiving interval of a transmit clock from the operating characteristic input means 5. Drawing 14 is a block diagram at the time of equipping the operating characteristic input means 5 with the receiving interval setting-out means 56. Next, the size of fluctuation explains the case where the gain of the gain means 22 is adjusted. A receiving interval is decided according to the specification of the system applied, and is suitably set as the receiving interval setting-out means 56.

0079 In the operating characteristic input means 5, based on the receiving interval set as the receiving interval setting-out means 56, control action characteristic information is given to the control means 4 so that the gain of the gain means 22 may be in inverse proportion to a receiving interval. that is, it coming out to the same delta frequency, and, since the value of the difference 102 will become large if a receiving interval is large, and the value of the difference 102 will become small if a receiving interval is small even if it is, For example, it enables it to output the control signal 104 which is the corresponding output as a suitable value because a value makes a gain small to the difference value which has become large because a receiving interval is large.

0080A case where a receiving interval is detected dynamically is explained. Drawing 15 is a block diagram at the time of having a receiving interval detection means 57 to detect a receiving interval from receiving timing of PCR100. PCR100 is inputted into this receiving interval detection means 57, that receiving interval is detected using an internal timer etc., and it is set as the receiving interval setting-out means 56.

0081 As an input, if the transmit-clock information 100 is inputted into the receiving interval detection means 7, it will record time which received the transmit-clock information by the receiving interval detection means 7 using an internal timer etc. And a difference with time which recorded the recorded time last time at the time of transmit-clock information reception is taken, and a receiving interval is computed.

0082 It inputs into the receiving interval setting-out means 56 by making a value which took one or a some times average for a computed receiving interval into receiving interval information. This detects a receiving interval of transmit-clock information automatically, and suitable clock reproduction control can be automatically performed by using this for gain control of the gain means 22 as mentioned above.

0083 Software may realize all or a part of such receiving interval detecting operation. Drawing 16 is a flow chart which shows such a case.

0084 At Step S21, transmit-clock information is received first. In Step S22, the receipt time of the above-mentioned transmit-clock information is measured with a timer etc., and is saved. In Step S23, a receiving interval is computed from the difference of this receipt time and the receipt time of transmit-clock information which received before. Receiving interval information is generated in Step S24. Although the generation method of receiving interval information exists **that it is various and** , in an easy example, there are the method of making what took the some times average of the receiving interval receiving interval information, etc. In Step S25, the computed receiving interval information is outputted to an operating characteristic input means. Thus, the receiving interval of transmit-clock information is detected automatically, and suitable clock reproduction control is automatically performed by using for control of the gain of ******.

0085 Although the embodiment of all above explained the case where the characteristic of the low pass filter 21 or the gain means 22 was changed in the control means 4, It is applicable to all the embodiments to acquire the same effect by preparing two or more low pass filters and gains with the different characteristic, and using it, choosing the low pass filter and gain which have the optimal characteristic by a selector etc.

Brief Description of the Drawings

Drawing 1 It is a block diagram of the clock reproduction equipment in this embodiment of the invention.

Drawing 2 It is a block diagram showing the example of composition of the control means in the clock reproduction equipment in this embodiment of the invention.

Drawing 3 It is an explanatory view explaining the characteristic of the low pass filter in this embodiment of the invention.

Drawing 4 It is an explanatory view explaining the example of the value of a gain, and the temporal change of a delta frequency in this embodiment of the invention.

Drawing 5 It is a flow chart which shows the clock reproduction operation in this embodiment of the invention.

Drawing 6 It is a block diagram of the clock reproduction equipment in this embodiment of the invention.

Drawing 7 It is a block diagram of the clock reproduction equipment in this embodiment of the invention.

Drawing 8 It is an explanatory view explaining the example of the difference of the clock information at the time of the clock reproduction control in this embodiment of the invention, and the rate of a temporal change of difference.

Drawing 9 It is a block diagram of the clock reproduction equipment in this embodiment of the invention.

Drawing 10 It is a block diagram of the clock reproduction equipment in this embodiment of the invention.
Drawing 11 It is a block diagram of the clock reproduction equipment in this embodiment of the invention.
Drawing 12 It is a block diagram of the clock reproduction equipment in this embodiment of the invention.
Drawing 13 It is a flow chart which shows the clock reproduction operation in this embodiment of the invention.
Drawing 14 It is a block diagram of the clock reproduction equipment in this embodiment of the invention.
Drawing 15 It is a block diagram of the clock reproduction equipment in this embodiment of the invention.
Drawing 16 It is a flow chart which shows the clock reproduction operation in this embodiment of the invention.
Drawing 17 It is a block diagram of conventional clock reproduction equipment.

Explanations of letters or numerals

1 Oscillator
2 Counter
3 Subtractor
4 Control means
5 Operating characteristic input means
21 Low pass filter
22 Gain means
51 Fluctuation information setting means
52 Fluctuation detection means
53 Difference rate-of-change detection means
54 Reproduction clock state setting-out means
55 Difference rate-of-change detection means
56 Receiving interval setting-out means
57 Receiving interval detection means

Drawing 1

For drawings please refer to the original document.

Drawing 2

For drawings please refer to the original document.

Drawing 3

For drawings please refer to the original document.

Drawing 4

For drawings please refer to the original document.

Drawing 5

For drawings please refer to the original document.

Drawing 6

For drawings please refer to the original document.

Drawing 7

For drawings please refer to the original document.

Drawing 9

For drawings please refer to the original document.

Drawing 10

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Drawing 8

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Drawing 11

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Drawing 12

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Drawing 13

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Drawing 14

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Drawing 15

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Drawing 16

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Drawing 17

For drawings please refer to the original document.

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